

# Recent developments on EME health: An international perspective

Professor Rodney Croft  
University of Wollongong, Australia  
Chair, International Commission on  
Non-Ionizing Radiation Protection (ICNIRP)

## The Developments that I'll Cover

1. ICNIRP 2020 RF EMF Guidelines
2. Recent rodent toxicology research
3. WHO Systematic Reviews



# 1. ICNIRP 2020 RF EMF Guidelines

- 100 kHz – 300 GHz
- Relevant to mobile telecommunications
- Replaced the 1998 RF Guidelines

OPEN

Special Submission

## GUIDELINES FOR LIMITING EXPOSURE TO ELECTROMAGNETIC FIELDS (100 kHz to 300 GHz)

International Commission on Non-Ionizing Radiation Protection (ICNIRP)<sup>1</sup>

**Abstract**—Radiofrequency electromagnetic fields (EMFs) are used to enable a number of modern devices, including mobile telecommunications infrastructure and phones, Wi-Fi, and Bluetooth. As radiofrequency EMFs at sufficiently high power levels can adversely affect health, ICNIRP published Guidelines in 1998 for human exposure to time-varying EMFs up to 300 GHz, which included the radiofrequency EMF spectrum. Since that time, there has been a considerable body of science further addressing the relation between radiofrequency EMFs and adverse health outcomes, as well as significant developments in the technologies that use radiofrequency EMFs. Accordingly, ICNIRP has updated the radiofrequency EMF part of the 1998 Guidelines. This document presents these revised Guidelines, which provide protection for humans from exposure to EMFs from 100 kHz to 300 GHz. *Health Phys.* 118(5):483–524; 2020

### INTRODUCTION

THE GUIDELINES described here are for the protection of humans from the adverse health effects of electromagnetic fields (EMFs) in the range 100 kHz to 300 GHz (hereafter “radiofrequency”). This publication replaces the 100 kHz to 300 GHz part of the ICNIRP (1998) radiofrequency guidelines, as well as the 100 kHz to 10 MHz part of the ICNIRP (2010) radiofrequency guidelines. Although these guidelines are based on the best science currently available, it is

recognized that there may be limitations to this knowledge that could have implications for the exposure restrictions. Accordingly, the guidelines will be periodically revised and updated as advances are made in the scientific knowledge. The present document describes the guidelines and their rationale, with Appendix A providing further details concerning the relationship between the guidelines and the scientific literature, and Appendix B providing further details concerning the biological and health effects reported in the literature.

### PURPOSE AND SCOPE

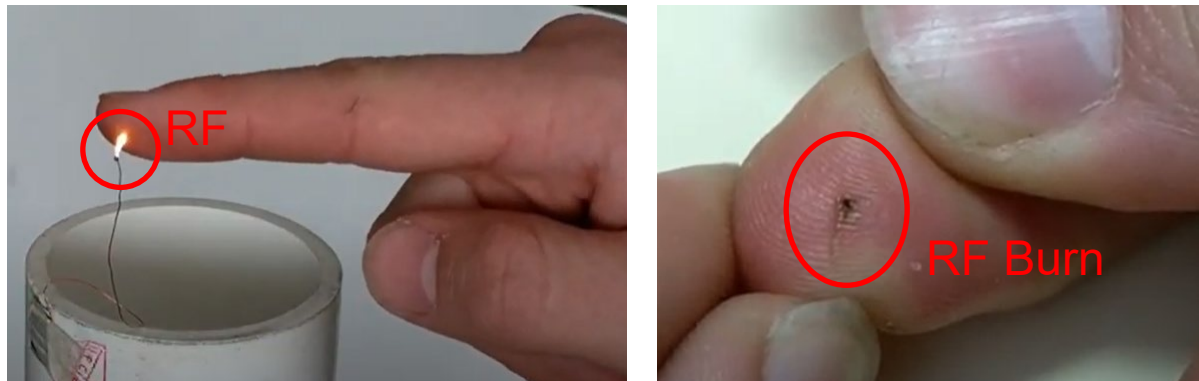
The main objective of this publication is to establish guidelines for limiting exposure to EMFs that will provide a high level of protection for all people against substantiated adverse health effects from exposures to both short- and long-term, continuous and discontinuous radiofrequency EMFs. However, some exposure scenarios are defined as outside the scope of these guidelines. Medical procedures may utilize EMFs, and metallic implants may alter or perturb EMFs in the body, which in turn can affect the body both directly (via direct interaction between field and tissue) and indirectly (via an intermediate conducting object). For example, radiofrequency ablation and hyperthermia are both used as medical treatments, and radiofrequency EMFs can indirectly cause harm by unintentionally interfering with active implantable medical devices (see IEC 2012) or

<sup>1</sup>ICNIRP, c/o BfS, Ingolstaedter Landstr. 1, 85764, Oberschleissheim, Germany

These are the guidelines that govern 5G-related exposure levels

## Why do we need RF EMF Guidelines?

- The effect of RF on human health varies greatly depending on a range of factors
- For example
  - It has no effect at low levels
  - But can be harmful at high levels

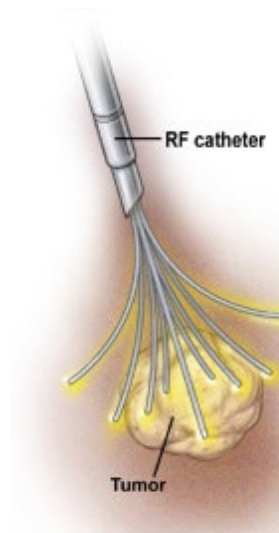


## Why do we need RF EMF Guidelines?

- There are also many important benefits that RF brings
- For example
  - Telecommunications (commerce, leisure, financial security)
  - Medical, industrial, domestic utility



Mobile telecommunications



RF Ablation



MRI Scans

***RF Guidelines*** provide a set of rules to avoid unsafe RF exposures, without unduly limiting beneficial uses of RF





# ICNIRP 2020 RF EMF Guidelines

- Provides protection for all people (incl. children, elderly, infirm, self-reported EHS), under realistic exposure conditions
- <https://www.icnirp.org/en/publications/article/rf-guidelines-2020.html>

OPEN

Special Submission

## GUIDELINES FOR LIMITING EXPOSURE TO ELECTROMAGNETIC FIELDS (100 kHz to 300 GHz)

International Commission on Non-Ionizing Radiation Protection (ICNIRP)<sup>1</sup>

**Abstract**—Radiofrequency electromagnetic fields (EMFs) are used to enable a number of modern devices, including mobile telecommunications infrastructure and phones, Wi-Fi, and Bluetooth. As radiofrequency EMFs at sufficiently high power levels can adversely affect health, ICNIRP published Guidelines in 1998 for human exposure to time-varying EMFs up to 300 GHz, which included the radiofrequency EMF spectrum. Since that time, there has been a considerable body of science further addressing the relation between radiofrequency EMFs and adverse health outcomes, as well as significant developments in the technologies that use radiofrequency EMFs. Accordingly, ICNIRP has updated the radiofrequency EMF part of the 1998 Guidelines. This document presents these revised Guidelines, which provide protection for humans from exposure to EMFs from 100 kHz to 300 GHz. *Health Phys.* 118(5):483–524; 2020

### INTRODUCTION

THE GUIDELINES described here are for the protection of humans against adverse effects from electromagnetic fields (EMFs) in the range 100 kHz to 300 GHz (hereafter “radiofrequency”). This publication replaces the 100 kHz to 300 GHz part of the ICNIRP (1998) radiofrequency guidelines, as well as the 100 kHz to 10 MHz part of the ICNIRP (2010) radiofrequency guidelines. Although these guidelines are based on the best science currently available, it is

recognized that there may be limitations to this knowledge that could have implications for the exposure restrictions. Accordingly, the guidelines will be periodically revised and updated as advances are made in the scientific knowledge. The present document describes the guidelines and their rationale, with Appendixes providing further detail concerning the relationship between the guidelines and the scientific literature, and Appendixes providing further detail concerning the biological and health effects reported in the scientific literature.

### PURPOSE AND SCOPE

The main objective of this publication is to establish guidelines for limiting exposure to EMFs that will provide a high level of protection for all people against substantiated adverse health effects from exposures to both short- and long-term, continuous and discontinuous radiofrequency EMFs. However, some exposure scenarios are defined as outside the scope of these guidelines. Medical procedures may utilize EMFs, and metallic implants may alter or perturb EMFs in the body, which in turn can affect the body both directly (via direct interaction between field and tissue) and indirectly (via an intermediate conducting object). For example, radiofrequency ablation and hyperthermia are both used as medical treatments, and radiofrequency EMFs can indirectly cause harm by unintentionally interfering with active implantable medical devices (see ISO 2012) or

<sup>1</sup>ICNIRP, c/o BS, Ingolstaedter Landstr. 1, 85764, Oberschleissheim,

These are the guidelines that govern 5G-related exposure levels

## Overall objective

- Define RF exposure levels, below which **harm will not occur**





## Overall objective

- This is important, because it means that reducing exposures even further will not provide additional safety



Bulgaria limit:  
2% ICNIRP

## Overall objective

- Such additional reductions are not supported by science (i.e. politically-based)



Bulgaria limit:  
2% ICNIRP

## Overall objective

- Weakness of analogy...



## Further work

- 100 kHz – 10 MHz restrictions were not updated because they were *also* related to ‘low frequency’ considerations
- These are now being updated as part of the low frequency Guidelines update (0 – 10 MHz); expected completion 2026



## 2. NTP rodent carcinogenicity studies

- National Toxicology Program (NTP) in the US conducted 2 large studies to try to determine whether RF caused cancer in rats and mice
- They reported that circa 2 years of RF exposure induced cardiac schwannoma in male rats (but not female rats, nor male mice, nor female mice)
- They interpreted this as ***clear evidence*** that RF exposure levels relevant to human telecommunications, causes cancer



## However

- Strongly criticized for a range of reasons (e.g. see ICNIRP critical evaluation; <https://www.icnirp.org/cms/upload/publications/ICNIRPnote20192020.pdf>)
- However, it is important because it was used as ammunition by activist groups to interfere with public health messaging

**ICNIRP NOTE: CRITICAL EVALUATION OF TWO RADIOFREQUENCY  
ELECTROMAGNETIC FIELD ANIMAL CARCINOGENICITY  
STUDIES PUBLISHED IN 2018**

International Commission on Non-Ionizing Radiation Protection (ICNIRP)<sup>1</sup>

---

*Abstract*—Final results are now available from two large animal studies that investigated whether long-term exposure to radiofrequency (RF) electromagnetic fields (EMFs) associated with mobile (or cell) phones or base stations is carcinogenic; these studies have

such as FM radio, radar, wireless routers, and mobile (cell) phones and associated base stations. As a result, humans are regularly exposed to RF EMFs, making it important to understand the relation between RF EMF exposure and health

## Follow-ups

- The NTP results can, at best, be seen as hypotheses in need of testing
- Accordingly, 2 replication studies are now under way to test the NTP claims (Japanese and South Korean labs)
- Main results will likely become available end of 2023
- However, an interim report at BioEM 2022 did provide initial support for one of the more interesting NTP findings
  - Rats exposed to RF were living longer



### 3. WHO Systematic Reviews

- WHO's Radiation Programme began reviewing the RF literature circa 10 years ago
- This has been delayed for a number of reasons, but is now nearing completion
- The outcome will be a set of systematic reviews that report on the scientific literature concerning RF exposure and health

## WHO Systematic Reviews

- Does not cover all areas of research
- Areas reviewed are based on a broad international survey of stakeholders in 2018
  - Cancer (epidemiology & animal studies)
  - Reproduction (epidemiology, animal & in vitro studies)
  - Cognitive impairment (epidemiology & human experimental studies)
  - Symptoms (epidemiology & human experimental studies)
  - Biomarkers of oxidative stress (in vitro studies)
  - Effect of heat (any source) on pain, cataracts & heat related illness

## WHO Systematic Reviews

- Most of the methods papers are now published
- Final review papers expected end of 2023 (-ish)



**Hang in there.**